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EXAMINER	
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ART UNIT	**PAPER NUMBER**
1753	

DATE MAILED: 10/24/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/881,116	ROBINSON ET AL.	
	Examiner	Art Unit	
	Rodney G. McDonald	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 January 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,10-24 and 29-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,10-24 and 29-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 1, 3-5, 15 and 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cuomo et al. (U.S. Pat. 4,250,009) in view of Ceasar et al. (U.S. Pat. 4,376,688).

Cuomo et al. teach an energetic particle beam accelerated towards a sputtering target. The target is located at an angle to the path of the beam (although it need not be). The target material which is dislodged by the ion beam can be directed towards a substrate. (See Abstract)

In Fig. 4 an evacuable sputter deposition chamber 14 is pumped down using normal vacuum procedures. The chamber is then filled with a gas. The target 10 and the substrate 12 are shown generally in the configuration shown in Fig. 2 with the addition of a wire mesh grid 13 above target 10 which serves to separate the electrons in the beam 11 from the ions to prevent the electrons form reaching the surface of target 12 thereby creating an excessive current through the target. (Column 4 lines 10-22)

In Fig. 10 target segments 30, 40, and 50 on holder 29 can be biased at different voltages Vt1, Vt2, Vt3, thereby varying the acceleration of the different segments will produce a variation in composition across the surface. The emphasis in resputtering can be change simply by varying the target polarity, i.e. dominant negative ions, then dominant positive ions bombardment of the surface. (Column 5 lines 44-51)

In Cuomo et al. the target can comprise a plurality of separate units each at a separately controlled voltage whereby selective application of potential thereto provides a multiplicity of simultaneously selectable combinations of coating and etching possibilities. (Column 6 lines 23-28)

The advantage that Cuomo et al. discusses is that it is possible to deposit positive and negative ions alternately or in a desired graded mixture at an interface under gradually changing voltage control. (See Abstract)

The differences between Cuomo et al. and the present claims is the time varying voltage is not discussed, the predetermined thickness is not discussed and the ion energy being less than about 50 eV or less is not discussed.

As to varying the voltage over time Cuomo et al. suggest gradually changing voltages to grade the coating. Such gradual change of voltage must occur over time. (See Cuomo et al. discussed above)

As to the predetermined thickness every coating deposited has a thickness. (See Cuomo et al. discussed above)

Ceasar et al. teach that beam energy for an ion beam, can be controlled from 0 to about 2000 eV. (Column 4 lines 27-31)

The motivation for controlling the beam energy is that it is more controllable than other deposition techniques. (Column 3 lines 63-67)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Cuomo et al. by utilizing a specific beam energy as taught by Ceasar et al. because it allows for controlling the deposition.

3. Claims 2 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cuomo et al. in view of Ceasar et al. as applied to claims 1, 3-5, 15 and 17-19 above, and further in view of Baldwin et al. (U.S. Pat. 6,419,802).

The difference not yet discussed is measuring the thickness with sensors to produce a signal for controlling the deposition to produce a desired thickness.

Baldwin et al. teach in FIG. 1A, a system 10 for controlling a circumferential deposition thickness distribution on a substrate 12. A motor 14 rotates the substrate 12 about axis 100, and a positioning sensor 16, generally a rotary shaft encoder, senses a rotary position of the substrate 12 during rotation of the substrate. At least one deposition thickness sensor 18 senses the deposition thickness of film material 13

deposited on the substrate 12 at multiple positions 19 (shown in FIG. 1B) on a circumference of a circle centered about an axis 100 of rotation the substrate 12. Although in the embodiment shown, substrate 12 is circular in shape, it will be understood that a substrate 12 that was square or some other shape could also be used with the present invention. A vapor source controller 20 drives a vapor source 22. The vapor source 22 creates a vapor flux plume 11 that is disposed proximate the substrate 12. The vapor flux plume 11 contains material 15 for deposition on the substrate 12 as deposited film material 13. The vapor source may be created by a target (as shown in FIG. 5) that is sputtered with high energy ions, a solid charge that evaporates as it is heated, or a chemical vapor deposition source. A process controller 24 is coupled to the motor 14, the shaft encoder 16, the deposition thickness sensor 18, and the vapor source controller 20. In another embodiment shown in FIG. 5, the vapor source controller 20 and the vapor source 22 may be a target power supply 20a that drives a target 22a that is used to sputter material 15 on the substrate 12. (Column 2 lines 40-68)

In the embodiment of FIG. 1, the process controller 24 is coupled to a film thickness monitor 23. It should be recognized by those skilled in the art that the functions of the process controller 24 and film thickness monitor 23 may be combined into a single controller. The film thickness monitor 23 is further coupled to one or more deposition thickness sensors 18 (only one of which is shown in FIG. 1) and one or more probe beams sources 25 (only one of which is shown in FIG. 1), each of which corresponds to one of the deposition thickness sensors 18. Probe drive signals are

fed into each probe beam source 25 by the film thickness monitor 23. Beams generated by each probe beam source 25 are reflected or scattered from the substrate and then sensed by a corresponding one of the deposition thickness sensors 18. Sensor signals (having values related to the deposition thickness on the substrate or the thickness of the substrate in combination with any deposited material) from each deposition thickness sensor 18 are fed into the film thickness monitor 23. Thickness data from the film thickness monitor 23 is then fed into the process controller 24 in order to monitor the deposition thickness of material 13 on the substrate. In one embodiment, the process controller 24 associates the thickness data provided by film thickness monitor 23 with rotary positioning data from the shaft encoder 16 in order to map the deposition thickness data to spatial positions on a circumference of substrate 12 during operation of system 10. (Column 3 lines 1-27)

In response to the mapped deposition thickness data derived from the signals from thickness monitor 23 and shaft encoder 16, process controller 24 varies the deposition rate of the emitted material 15 from the vapor source 22 synchronously in accordance with the rotary position of the substrate 12. As shown in FIG. 1, vapor flux plume 11, with its depositable material 15, is divergent and is not aimed in an axi-symmetric fashion at substrate 12. Such flux may be formed, for example, by directing an ion current at a given position on a planar target that is not coaxial with the substrate. As a result, as seen in FIG. 1A, the deposition rate of material 15 onto film material 13 on substrate 12 will be higher for portions of the substrate that are closer to the vapor source 22, and lower for portions of substrate 12 positioned farther away from

vapor source 22. As a result of this geometry, process controller 24 is able to increase/decrease the deposition rate of material 13 along any given circumferential (or azimuthal) section of substrate 12 by simply slowing down/speeding up the rotation rate of substrate 12 as the given circumferential (or azimuthal) section passes closest to vapor source 22 during rotation of the substrate. Alternatively, in cases where a constant rotation rate is desired, process controller 24 can vary the deposition rate of material 13 at any given circumferential section of substrate 12 by increasing/decreasing the rate of material emitted from source 22 as the given circumferential section passes closest to vapor source 22. It will be understood by those skilled in the art that the deposition rate at any given circumferential section of substrate 22 can therefore be varied by either adjusting the rate of emissions from source 22, the speed of rotation of substrate 12, or combination thereof, as the given circumferential section passes closest to vapor source 22 during each of its rotations. (Column 3 lines 52-68; Column 4 lines 1-17)

The motivation for utilizing thickness sensors to provide a signal for controlling deposition rate is that it allows for controlling the deposition thickness distribution. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized sensors to measure thickness and provide a control signal to control deposition rate of material from a deposition source as taught by Baldwin et al. because it allows for controlling the deposition thickness distribution.

4. Claims 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cuomo et al. in view of Ceasar et al. as applied to claim 1 above, and further in view of Kanda et al. (U.S. Pat. 5,089,104).

The difference not yet discussed is the use of a reactive ion assist beam where reactive gas is admitted to the chamber and directed at the substrate.

Kanda et al. teach that Ion beams drawn out of a plurality of ion beam sources or neutralized beams derived therefrom are projected to a plurality of targets, and sputtered particles discharged from the targets are directed to a substrate. The composition of sputtered particles is measured in the vicinity to the substrate. The measured composition is compared with the predetermined reference value and the composition of sputtered particles is controlled based on the result of measurement. Sputtered particles having a controlled composition distribution are deposited on the substrate thereby to form a multiple-element thin film. (See Abstract)

The inventive method and apparatus are capable of controlling the concentration of each constituent accurately, and they are applicable favorably to the film formation of multiple-element compounds which need composition control, e.g., multiple-element oxides, multiple-element nitrides, multiple-element metallic compounds and alloys, gradient compounds, gradient alloys, and artificial super lattices. (Column 3 lines 4-11)

The above objective is namely to accomplish a film forming method and apparatus based on the simultaneous multiple-element ion beam sputtering, in which ion beam sources or neutral beam sources, at least equal in number to targets, are disposed and sputtered particles discharged from each target are deposited evenly at a

controlled concentration on a substrate. During the film formation, the composition ratio of sputtered particles which pass by the substrate surface is measured by using the atomic absorption method, the measured data is rendered the computation process, and the acceleration voltage and the ion beam current density of each ion beam source are adjusted so as to achieve a proper composition ratio of sputtered particles thereby to control the concentration of sputtered particles. (Column 3 lines 12-26)

The ion beam sources use such rare gas as argon, or even oxygen or nitrogen depending on the composition of film. The beams of this type are charged electrostatically in general, and therefore in the case of targets made of insulator, e.g., oxide, the ion beams may be neutralized through a neutralizing filament before the beams are projected to the targets thereby to prevent the targets from being charged, when necessary. In case a constituent of the intended thin film composition includes an element which is gaseous or liquid at the room temperature, e.g., oxygen and water, it is also possible to feed the element together with an ion beam such as of argon directly to the intended thin film by means of the ion beam or neutral beam. (Column 4 lines 44-57)

Through the use of an ion beam source as an assistant ion beam source for projecting a low-energy ion beam or neutral beam of oxygen, nitrogen or the like to the substrate, it becomes possible to control the deficiency of oxide, nitride, etc., or to form a crystalline thin film with anisotropy in the crystal growing direction. (Column 5 lines 20-25)

The inventive method and apparatus of thin film formation, in which the concentration of constituents can be controlled accurately, are suitable for the film formation of multiple-element compounds which necessitate the precise composition control, e.g., multiple-element oxides, multiple-element nitrides, multiple-element metallic compounds, alloys, gradient compounds, gradient alloys, and artificial super lattices. (Column 5 lines 38-45)

Targets were each made of metallic titanium, aluminum, silicon and gold. Initially, a film of titanium is formed for about 50 Angstroms on a silicon substrate, and thereafter nitrogen gas is introduced gradually from the assistant ion beam source 9 so that a compositional slope from titanium layer to titanium nitride layer is formed continuously. The output of the ion beam source which sputters the aluminum target is raised gradually so that an intermediate layer made of titanium, aluminum and nitrogen is formed. After that, the output of the ion beam source which sputters the titanium target is lowered gradually so that an insulation aluminum nitride layer is formed. (Column 8 lines 34-47)

The motivation for utilizing an additional ion beam directed as at the substrate that allows reactive gas in the chamber is that it allows for growing a crystalline film. (Column 5 lines 20-25)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a reactive ion assist beam where reactive gas is admitted to the chamber and directed at the substrate as taught by Kanda et al. because it allows for growing a crystalline film.

5. Claims 10, 12-14, 20, 22-24 and 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kanda et al. (U.S. Pat. 5,089,104) in view of Cuomo et al. (U.S. Pat. 4,250,009) and Ceasar et al. (U.S. Pat. 4,376,688).

Kanda et al. is discussed above and teach utilize voltage and current of ion beams to control deposition. (See Kanda et al. discussed above)

The differences between Kanda et al. and the present claims is that controlling the voltage to the ion beam sputtering targets to control deposition is not discussed and controlling the ion beam energy to be less than 50 eV or less is not discussed.

Cuomo et al. is discussed above and teach utilizing voltage to ion beam sputtering targets to control deposition. (See Cuomo et al. discussed above)

The motivation for controlling the voltage to ion beam sputtering targets is that it allows for selecting the combinations of coating. (See Cuomo et al. discussed above)

Ceasar et al. is discussed above and teach utilizing ion beam energy of 50 eV or less. (See Ceasar et al. discussed above)

The motivation for controlling the beam energy is that it is more controllable than other deposition techniques. (Column 3 lines 63-67)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Kanda et al. by controlling the voltage to ion beam sputtering targets as taught by Cuomo et al. and to have utilized a specific beam energy as taught by Ceasar et al. because it allows for selecting the combinations of coating and for controlling the deposition.

6. Claims 11 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kanda et al. in view of Cuomo et al. and Ceasar et al. as applied to claims 10, 12-14, 20, 22-24 and 30-32 above, and further in view of Baldwin et al. (U.S. Pat. 6,419,802).

The difference not yet discussed is measuring the thickness with sensors to produce a signal for controlling the deposition to produce a desired thickness.

Baldwin et al. is discussed above and teach measuring the thickness with sensors to produce a signal for controlling the deposition to produce a uniform distribution thickness. (See Baldwin et al. discussed above)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized sensors to measure thickness and provide a control signal to control deposition rate of material from a deposition source as taught by Baldwin et al. because it allows for controlling the deposition thickness distribution.

7. Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cuomo et al. In view of Ceasar et al. and further in view of Baldwin et al. as applied to claims 1-5 and 15-19 above ***OR*** Kanda et al. in view of Cuomo et al. and Ceasar et al. and further in view of Baldwin et al. as applies to claims 10-14, 20-24 above, and further in view of Kaufman et al. (U.S. Pat. 4,862,032).

The difference not yet discussed is the use of an end Hall ion source.

Kaufman et al. teach in Fig. 1 an end-hall ion source. An end-hall ion source 20 includes a cathode 22 beyond which is spaced an anode 24. On the side of anode 24

remote form cathode 22 is an electromagnet winding 26 disposed around an inner magnetically permeable pole piece 28. (Column 3 lines 19-23)

The motivation for utilizing an end Hall ion source is that it allows for an ion beam produced with high-current and low energy. (Column 2 lines 24-26)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized an end Hall ion source as taught by Kaufman et al. because it allows for producing an ion beam with high-current and low energy.

Response to Arguments

Applicant's arguments filed 1-27-05 have been fully considered but they are not persuasive.

In response to the argument that the prior art of record does not suggest utilizing an ion beam energy that is at or below 50 eV and the target or plurality of targets being biased negatively to ground, it is argued that the combination of references when taken as a whole do suggest providing a target or plurality of targets being negatively biased with respect to ground and utilizing an ion beam energy that is at or below 50 eV. Specifically Cuomo et al. teach providing a negative bias to targets for ion beam sputtering and Ceasar et al. teach utilizing an ion beam having an energy in the range of 0-2000 eV. (See Cuomo et al. and Ceasar et al. discussed above)

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon

hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

In response to the argument that the Board was persuaded that by Kaufmann's declaration that sputtering using the ion source referred to by Ceasar et al. was impossible at an ion beam energy at or below 50 eV unless that target has a negative bias, it is argued that the Board stated that the references must be taken as whole when determining whether the prior art suggests utilizing an ion beam energy of at least 50 eV or less. When taken as a whole the combination of Ceasar et al. and Cuomo et al. do suggest Applicant's claim limitations and such combination would be capable of operating to sputter negatively biased targets with an ion beam energy of 50eV or less. (See Ceasar et al. and Cuomo et al. discussed above)

Applicant's declaration is not found convincing because the references when considered as whole suggest utilizing a low ion beam energy because the targets are applied with a negative potential.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 571-272-1340. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Rodney G. McDonald
Primary Examiner
Art Unit 1753

RM
October 18, 2005